IBM

D/670

B/310

INSTRUCTION MANUAL

FOR

PRECISION DC VOLTMETER

MODELS DC-200B/BR
DC-150B/BR
DC-110B/BR

ELECTRONIC INSTRUMENTATION FOR INDUSTRY

CALIBRATION STANDARDS CORPORATION *a subsidiary of* ROYAL INDUSTRIES, INC.

PRECISION DC VOLTMETER

MODELS DC-200B/BR
DC-150B/BR
DC-110B/BR

SERIAL 2189

CALIBRATION STANDARDS CORPORATION

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Alhambra, California

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IMPORTANT

FOR OPTIMUM RESULTS, PLEASE READ THE INSTRUCTION MANUAL CAREFULLY.

This instrument you have purchased represents a major advance in the field of transistorized precision test equipment.

Since this instrument incorporates the latest engineering techniques and design, it is imperative that you become familiar with the proper operating procedure.

Meter zeroing adjustment is performed at the factory. Normally no further adjustment is required. Should adjustment be necessary, the meter may be zeroed by the mechanical adjustment screw on the meter itself while the instrument is operating.

OPERATING INSTRUCTIONS

1. The line cord should be plugged into a 117-volt 60-cycle power source. (220 volt if indicated)
2. Turn the null selector to TVM position and power switch on. Let the instrument warm up for approximately 10 minutes.
3. Check mechanical zero of meter. If necessary, adjust to zero by means of the screw in the center of the meter case.
4. Turn the range selector knob to the desired range. Connect the voltage to be measured to the terminal posts. Either positive or negative may be grounded to the common terminal. When operating with the polarity switch in the positive mode, the negative terminal is generally grounded to the case or left floating and in the negative mode, the reverse.
5. The voltage now indicated on the meter is accurate within 4%. If the meter needle swings to the left, turn the polarity switch to the NEG position.
6. Position first two readout dials to the approximate TVM voltage reading. Advance the null selector knob to the 1 V position. Continue to adjust the readout while increasing the null sensitivity. You are now zeroing in on the null.
7. When, by the procedure above, the null selector is at full sensitivity (1 MV) and the meter reading zero, the voltage read from the dials is accurate to better than the rated accuracy of the instrument. Because the sensitivity of your instrument in the 1 MV null position is higher than the stability of many sources, you may not get a reading of zero if the voltage you are measuring is not constant and is fluctuating.

OPERATING INSTRUCTIONS (Continued)

READING EXCURSIONS ABOUT A NOMINAL VOLTAGE

8. To read excursions of voltage about a nominal value, set the readout dials to the nominal value. Excursions may be observed directly on the meter on any of the four null ranges. A right hand deflection of the meter indicates the voltage has increased above the nominal value by the amount indicated on the meter. For voltages read on the 10-volt range and below, use null sensitivity selector as marked. On the 100-volt ranges, the null sensitivity selector value must be multiplied by a factor of 10. On the 1000-volt range the null sensitivity selector value must be multiplied by a factor of 100.

DIRECT MEASUREMENTS OF 10 VOLTS AND ABOVE

9. With the range selector in the 10-volt position, use full scale values as marked on the meter. When range selector is in the 100-volt position, multiply the meter reading by 10. On the 1000-volt range, multiply the reading by 100.

VARIATIONS IN NULL DETECTOR SENSITIVITY

10. Due to the circuit design on the 100-volt range, the null detector will have reduced sensitivity on the 1 mv and 10 mv positions. This is due to a high internal source impedance of the high voltage input divider. The sensitivity is about 50% less in the 1 mv null position and about 15% less on the 10 mv position. Only a very slight loss of sensitivity is noticed on the other null ranges. When the range selector is in the 1000-volt position, a 10% loss of sensitivity will be noticed in the 1 mv position.

OPERATING INSTRUCTIONS (Continued)

The other null ranges will have only a very slight loss of sensitivity.

MEASUREMENTS BELOW 1 VOLT IN DIFFERENTIAL MODE

11. When making measurements below 1 volt, turn Range Selector switch to the 1-volt position. Set null selector to the 1 mv position. Set all readout dials to zero and short positive and negative input terminals together.

12. Now set the mechanical meter adjustment to zero. This will cancel out error due to zero offset between the 1 millivolt range and the VTVM range. Remove short across terminals and proceed with the reading of voltage per paragraphs 4, 5, 6, and 7.

"POS" AND "NEG" POLARITY

13. This instrument is capable of measuring both positive and negative voltages without reversing the input connections, by setting the polarity switch in the correct position.

Under some conditions the reading in the "NEG" position may differ from the "POS" position. This difference is very small in comparison to the rated accuracy of the instrument. Since the instrument is calibrated in the "POS" position, the best accuracy will result when the polarity switch is in this position.

OPERATING INSTRUCTIONS (Continued)

RECORDER OUTPUT

14. Two sets of output terminals are located on the rear of the voltmeter. One set is the recorder output and the other is the Kelvin-Varley output. The output voltage of the recorder output terminals is ±25 mv for a full scale deflection. The output impedance is approximately 200Ω. Any recorder may be used so long as the leakage resistance to the line or ground is better than 10,000 megohms.

When using high speed recorders, it may be necessary to install a filter between the output terminals of the voltmeter and the input of the recorder. The output signal of the voltmeter will have the demodulated chopper signal and must be filtered out. Generally a three-stage RC filter using 33K resistors and 1 mfd capacitors will be sufficient.

KELVIN-VARLEY OUTPUT

15. The second set of terminals provide an output from the Kelvin-Varley Divider. The maximum output is 10 vdc when the instrument range selector is in the 10-volt position. A chart showing the output impedance of the KVD is located in the back of this manual.

CIRCUIT DESCRIPTION

This Calibration Standards Corporation Voltmeter is completely transistorized and designed for long, trouble-free life. There are no batteries or components that would normally need replacing.

This dependable voltmeter operates on the principle of comparing an unknown voltage with an adjustable known voltage. A sensitive null detector is used to provide a means of sensing when the known and unknown voltages are equal.

This Calibration Standards Corporation Voltmeter is composed of three basic elements:

(1) An ultra stable reference supply.

(2) An accurate Kelvin-Varley divider.

(3) A sensitive null detector.

CIRCUIT DESCRIPTION (Continued)

1. The heart of the voltmeter is the ultra stable reference voltage supply. This supply is a dual regulated transistor supply powering a compensated Zener reference string. The transistors and Zener diodes are silicon, and therefore will withstand high temperatures without impairing the life of the assembly. Following is a performance chart of the references.

Specification	DC-200B/BR	DC-150B/BR	DC-110B/BR
Regulation for 10% line change, 15°C to 40°C	±0.001%	±0.001%	±0.002%
Temperature coefficient	±2 ppm/°C	±3 ppm/°C	±5 ppm/°C
Long-term stability of Zener - typical	±10 ppm	±10 ppm	±20 ppm
- maximum	±20 ppm	±20 ppm	±40 ppm

This reference voltage supply is constructed as a printed circuit assembly. Spares and replacements are available from the factory. When ordering, be sure to indicate the serial number of the instrument.

CIRCUIT DESCRIPTION (Continued)

2. The second basic element is the very accurate Kelvin-Varley Divider. All readout decks except the last have 11 carefully matched precision wire-wound resistors. The chart below shows the maximum Kelvin-Varley divider linearity and yearly stability.

Model	Linearity	Maximum Stability	Typical Stability
DC-200B/BR	±20 ppm	±5 ppm	±1-2 ppm
DC-150B/BR	±25 ppm	±5 ppm	±1-2 ppm
DC-110B/BR	±75 ppm	±20 ppm	±3-5 ppm

Since the divider resistors operate at very low power ratings, the long-term stability of the divider is that of the long-term ratio stability at shelf-life. The resistors are preaged and tested for best stability before installation in the instrument.

The resistors used in the first deck of the DC-200B/BR and DC-150B/BR Kelvin-Varley Divider are the most stable type of resistor possible to manufacture. They are wound with very little strain and are sealed in silicon oil. Resistors of this type are also utilized in the range divider network.

The range selector precedes the Kelvin-Varley Divider. Each range has a fine adjustment potentiometer for calibration. Each is calibrated separately.

CIRCUIT DESCRIPTION (Continued)

3. The third element is a very sensitive and stable calibrated null detector. This null detector is used to indicate the difference between an unknown external voltage and a known internal voltage. At maximum sensitivity the null detector has a full-scale deflection of 1 mv. This provides ample sensitivity for accurate low-level voltage measurements. The TVM accuracy is ±4% of full scale over a temperature range of 10°C to 40°C. The instrument is usable to 50°C but some derating should be considered.

The null detector is capable of a long, trouble-free life except for the occasional replacement of the chopper. These are highly reliable, however, do occasionally need replacement. Choppers are available from stock at the factory. The occasional calibration of the null detector may be made by adjusting the gain-adjustment potentiometer, R32, located in the amplifier printed circuit board. An electrical zero control, R31, is also located on this board.

The null detector is capable of large overloads without damage. On the 1 mv range a safe overload would be 50 volts short-term and 10 volts long-term. On the 10 mv, 100 mv, and 1V positions, a safe overload of 500 volts is possible.

CIRCUIT DESCRIPTION (Continued)

In the VTVM position ranges, safe overloads are as follows.

1-volt range:	70 volts
10-volt range:	250 volts
100-volt range:	700 volts
1000-volt range:	1500 volts

CALIBRATION

Diagram A1078 shows a setup for calibrating this instrument.

A. CALIBRATION OF THE DIFFERENTIAL SECTION

The "RANGE SELECTOR" - "10V" range is calibrated first. On this range the instrument has an infinite input resistance at null.

1. Check mechanical zero of meter. If necessary, adjust to zero by means of the screw in the center of the meter case.
2. Next, turn "NULL SELECTOR" to the TVM position and power switch on. Check electrical zero of meter. If necessary, adjust to zero by means of R31.
3. Apply a known 10-volt calibration voltage across the "POS" and "NEG" input terminals. The instrument meter should read full scale. Turn "READOUT" dials to read (9). (9) (9) (9) (10) and turn "NULL SELECTOR" switch to the "1 MV" position. Bring meter to zero by adjusting the appropriate calibration trim potentiometer. (See calibration board component layout.)
4. Repeat the basic procedure for calibration of the "1V" range using a known 1 volt. Repeat the basic procedure for calibration of the "'00 mv" range using a known 100 mv source. (Omit where not applicable.)
5. The "RANGE SELECTOR" - "100V" and "1000V" ranges are calibrated next. On these ranges the instrument has a 2 megohm input resistance.
6. Turn the "RANGE SELECTOR" switch to the "100V" position and apply a known 100-volt calibration voltage at meter input. Continue basic calibration procedure outlined in Paragraph 3.

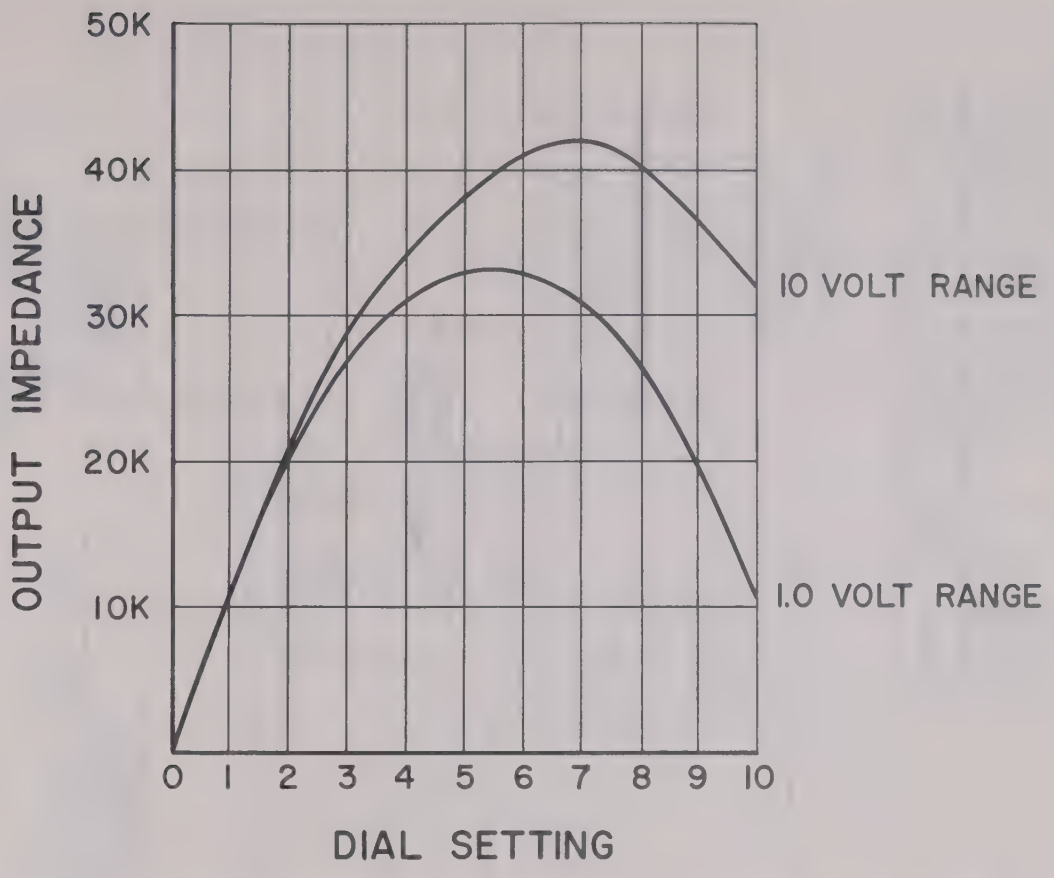
Note: Multiply "NULL SELECTOR" ranges by 10.

CALIBRATION (Continued)

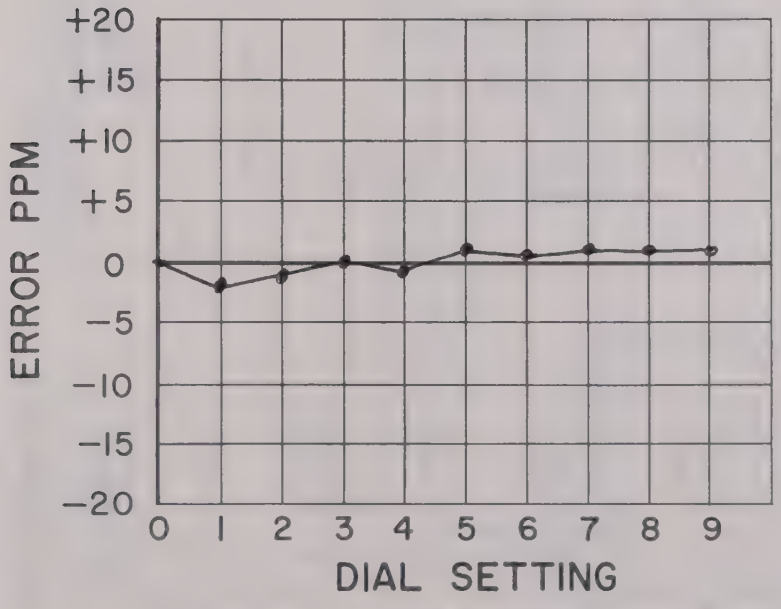
7. Turn the "RANGE SELECTOR" switch to the "1000V" position. Apply a known 500 volts with the "READOUT" dials turned to (5) (0) (0) (0) (0) (0). Bring meter to zero by adjusting the appropriate trim potentiometer.

B. CALIBRATION OF THE TVM RANGES

Calibrate the TVM Ranges by setting the "RANGE SELECTOR" switch to the "10V" position and apply a known 10-volt calibration voltage. Adjust potentiometer R32 for full-scale deflection. It is not necessary to calibrate the remaining TVM ranges.



OUTPUT IMPEDANCE OF REFERENCE / KVD



KELVIN VARLEY DIVIDER CALIBRATION CHECKED AGAINST CSC 1 PPM MASTER DIVIDER.

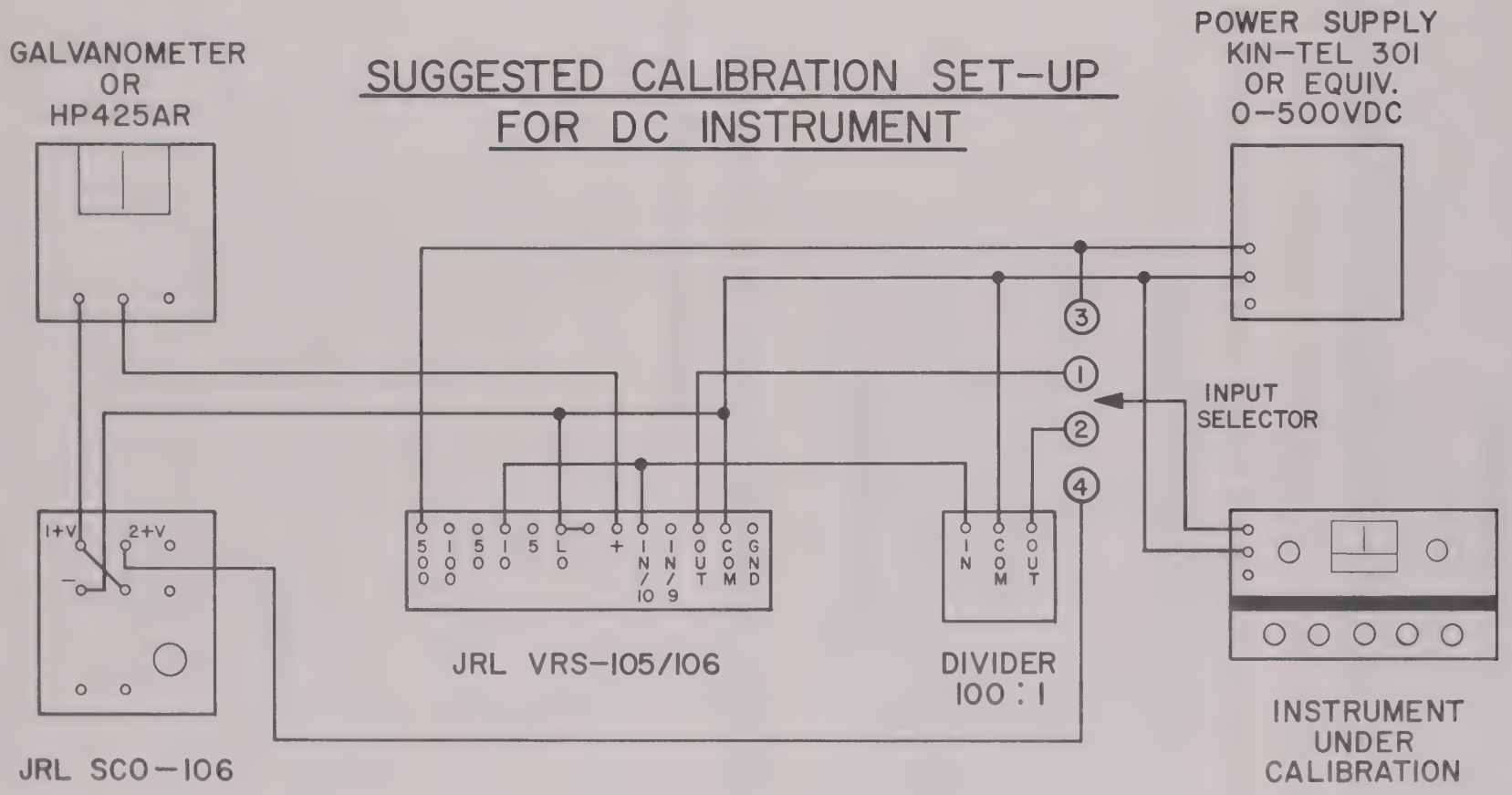
KVD CALIBRATION CHART

INSTRUMENT MODEL DC200B INSTRUMENT SERIAL NO. 2189

JULIE RESEARCH LABS MODEL SCO-106 CELL ACCURACY 1-2PPM.

JULIE RESEARCH LABS MODEL VRS-105/106 ACCURACY 10PPM CALIBRATOR-10PPM RATIO.

SUGGESTED CALIBRATION SET-UP FOR DC INSTRUMENT



3. CARE SHOULD BE TAKEN WHEN OPERATING INSTRUMENT IN NEGATIVE MODE AS SHORTS MAY DAMAGE OR SHORTEN LIFE OF TEST EQUIPMENT.
2. FOR CALIBRATION OF 100MV RANGE DIVIDER SHOULD BE OF AT LEAST 20PPM ACCURACY.
1. FOR CALIBRATION OF 1.0V RANGE SET RATIO ON DIVIDER (JRL) TO 1.

NOTES:

RANGE	INPUT SELECT.	POWER SUPPLY	VRS RATIO	VRS 105
1000V	3	500V	N. U.	500V
100V	3	100V	N. U.	100V
10V	4	10V	N. U.	10V
1.0V	1	10V	10 : 1	10V
100MV	2	10V	N. U.	10V

WARRANTY

The CALIBRATION STANDARDS CORPORATION warrants each instrument to be free from defects in material and workmanship. The instrument must be returned to the factory with shipping prepaid and a complete report of the difficulty. This warranty is good for one year from the shipping date.

SHIPPING DAMAGE

If there is any damage to the instrument upon receipt, report this to the transportation claim agent immediately.

NEW PRODUCT ANNOUNCEMENT

Precision DC Voltmeter

CALIBRATION STANDARDS CORPORATION

Accuracy

±0.01% +5 microvolts from 0-1000 VDC, ±0.003 typical accuracy

ACCURACY .0075%

Stability

±0.001% for a 10% line change

MODEL DC-200B/BR

General Description

ACCURACY .0075%

The Model DC-200B/BR Precision DC Voltmeter provides ±0.01% ±5 microvolts accuracy with an all solid state design.

The reference is an ultra-stable temperature compensated Zener element with .002% yearly stability, .001% yearly stability typical.

The Zener reference drives a 6-digit Kelvin-Varley Divider with .002% dividing accuracy. The difference is amplified by a chopper stabilized null detector which drives a taut band meter.

Each instrument is tested from 10°C to 40°C and must have a total instrument stability of ±5 ppm/°C.

....100% silicon transistorized (no batteries or vacuum tubes)

....6-digit in-line readout 7-digit resolution

....decimal lights

....polarity reversal switch

....recorder output (0-25 mv)

....reference output

....ultra-stable Zener reference

....taut band meter

CALIBRATION STANDARDS CORPORATION

1031 WESTMINSTER AVE.
POST OFFICE BOX 551
ALHAMBRA, CALIFORNIA

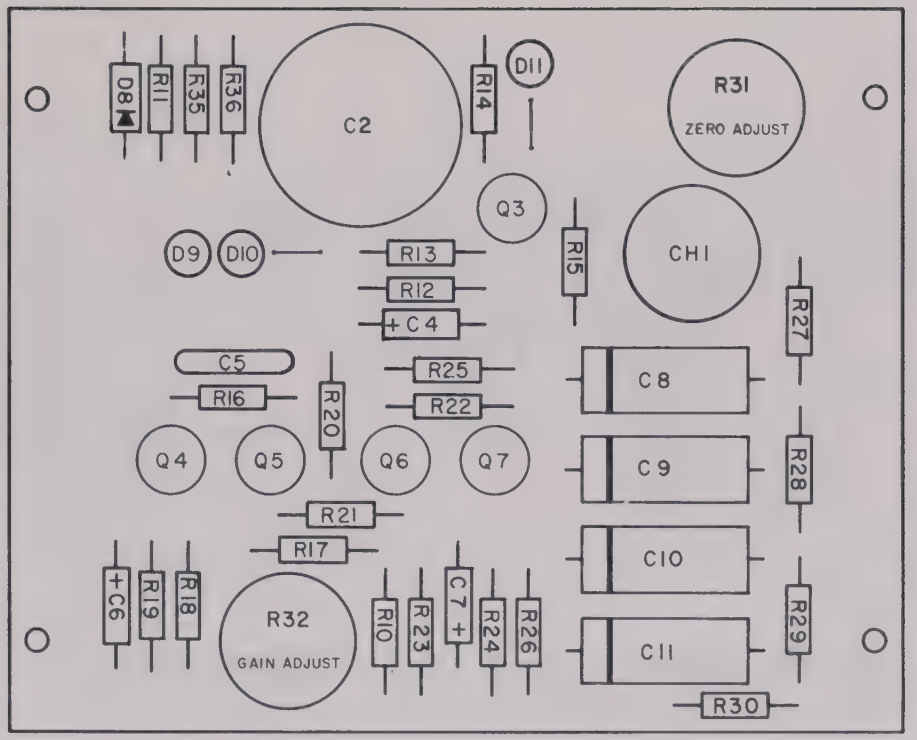
A subsidiary of ROYAL INDUSTRIES, INC.

MODEL DC-200B/BR
SPECIFICATIONS

VTVM Ranges:	1-0-1 VDC, 10-0-10 VDC, 100-0-100 VDC, 1000-0-1000 VDC
VTVM Accuracy:	±4% full scale
Null Ranges:	1-0-1 mv, 10-0-10 mv, 100-0-100 mv, 1-0-1 V (Times 10 on 100-volt range) (Times 100 on 1000-volt range)
Precision Ranges:	0-1 VDC, 1.0-10 VDC, 10-100 VDC, 100-1000 VDC
Accuracy of Precision Ranges:	ACCURACY .0075% ±0.01% ±5 microvolts
Kelvin-Varley Divider Accuracy:	±0.002% of reading from 1/10 full scale to full scale
Input Resistance:	Infinite at null below 10 VDC, 2 megohms above 10 VDC

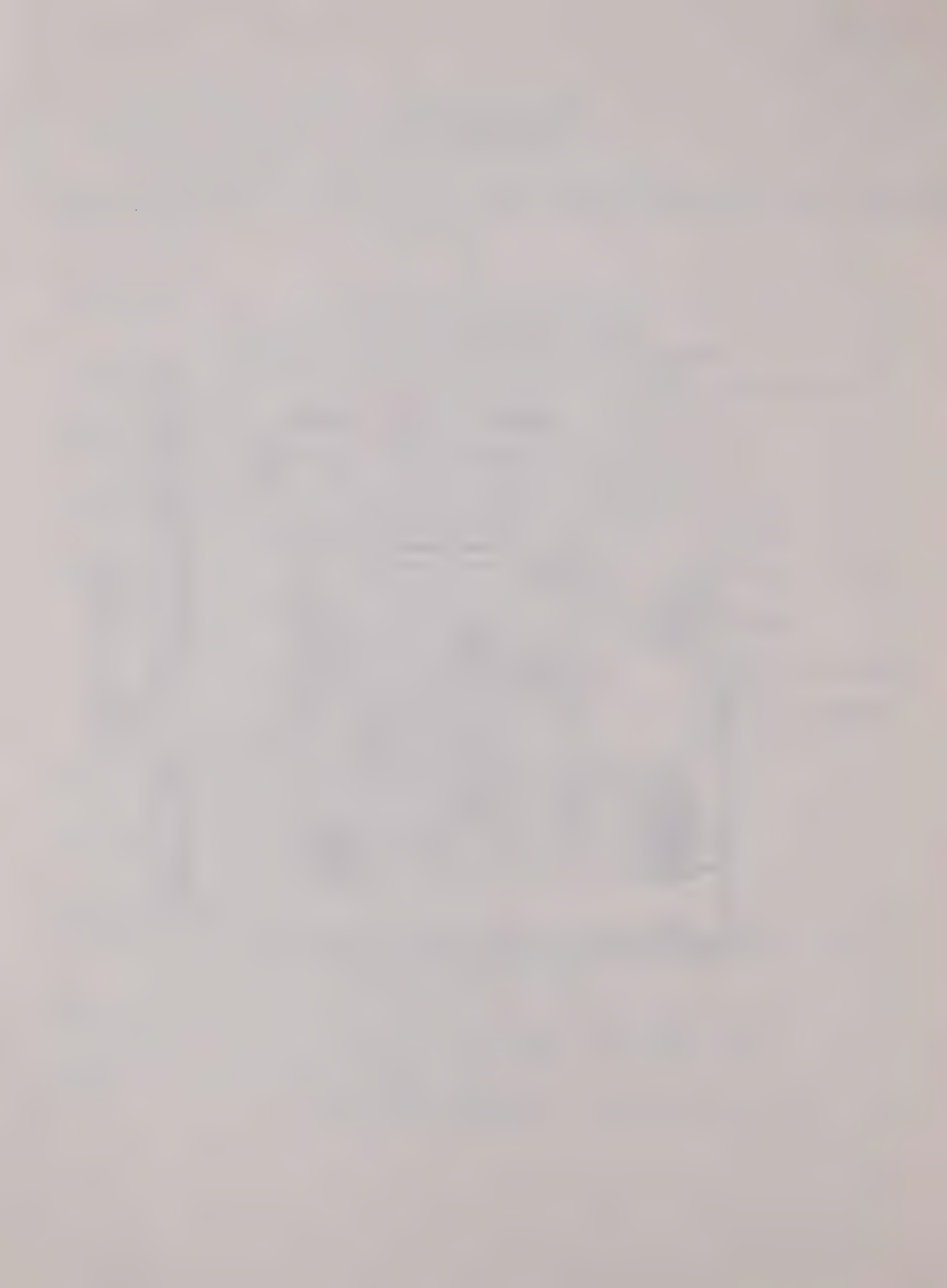
VTVM Resistors	Null Ranges
1000 volts) 100 volts) - 10 megohms 10 volts) 1 volt - 1 megohm	1.0 volt) - 10 megohms 0.1 volt) 0.01 volt - 1 megohm 0.001 volt - 300K

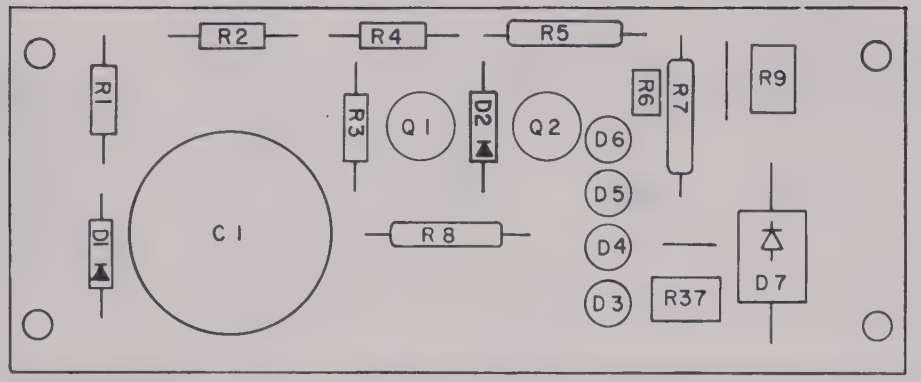
Stability of Reference:	±0.001% for a 10% line change ±0.0002%/°C from 15°C to 40°C
Warmup:	Less than 10 minutes for .02% accuracy Less than 30 minutes for .01% accuracy
Input Voltage and Power:	117 VAC, 50-60 cps - 50-400 cps operation is available for all instruments for an additional $60.00. Less than 5 watts of power
Weight and Size:	DC-200B - 10 pounds, 7"H x 14.5"W x 11"D DC-200BR - 12 pounds, 7"H x 19"W x 8"D
Price:	DC-200B - $965.00) DC-200BR - $985.00) - fob Alhambra, California



COMPONENT LOCATION AMPLIFIER

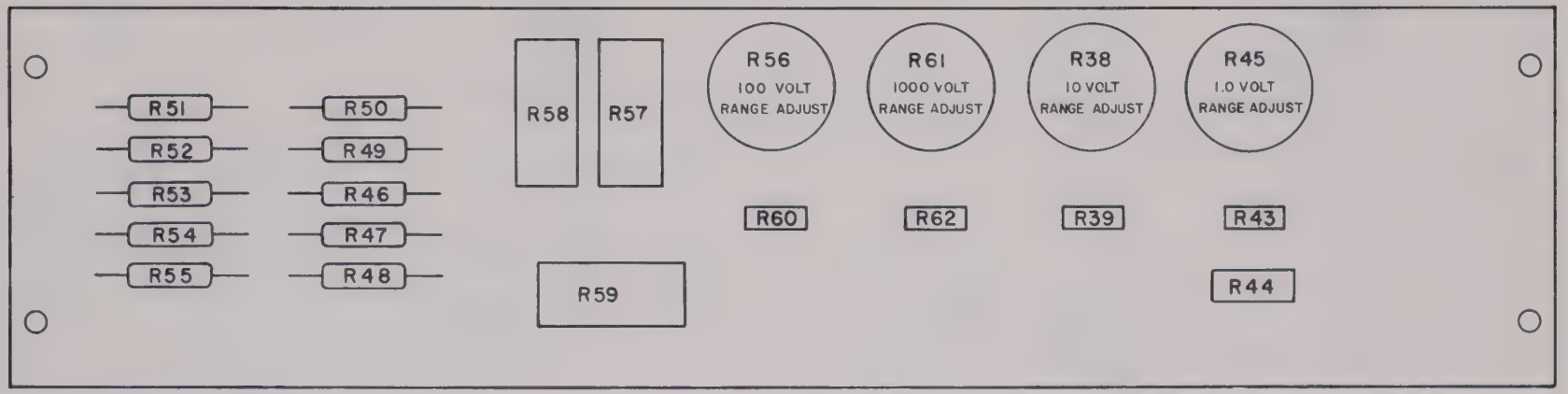
400—106





COMPONENT LOCATION REFERENCE

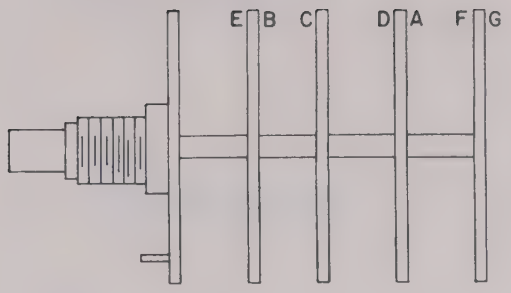
400-107



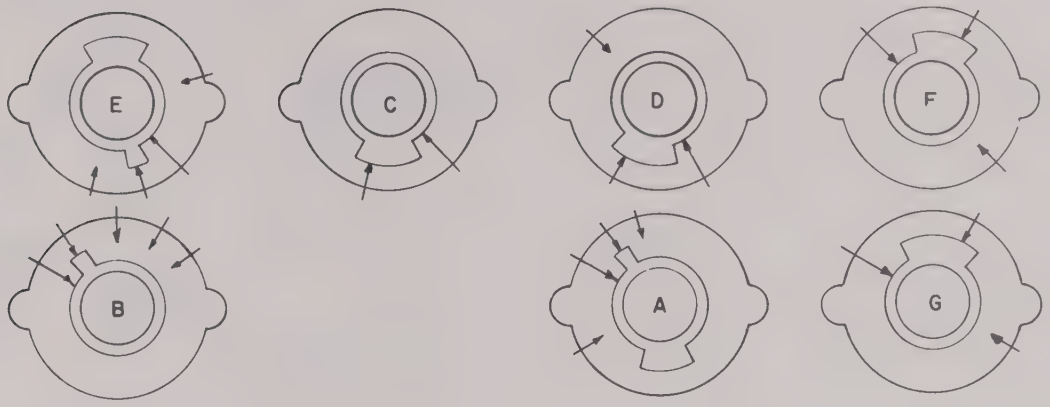
COMPONENT LOCATION CALIBRATION

400-108

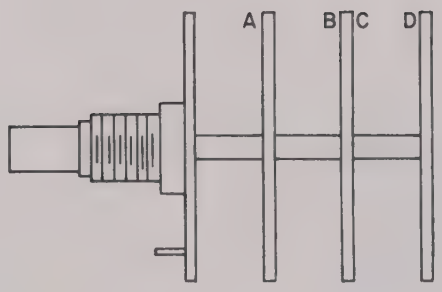
S2



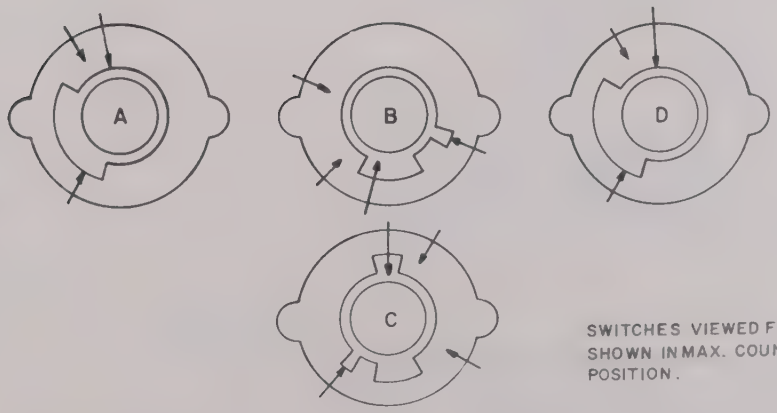
RANGE SWITCH
(PART 240-045)



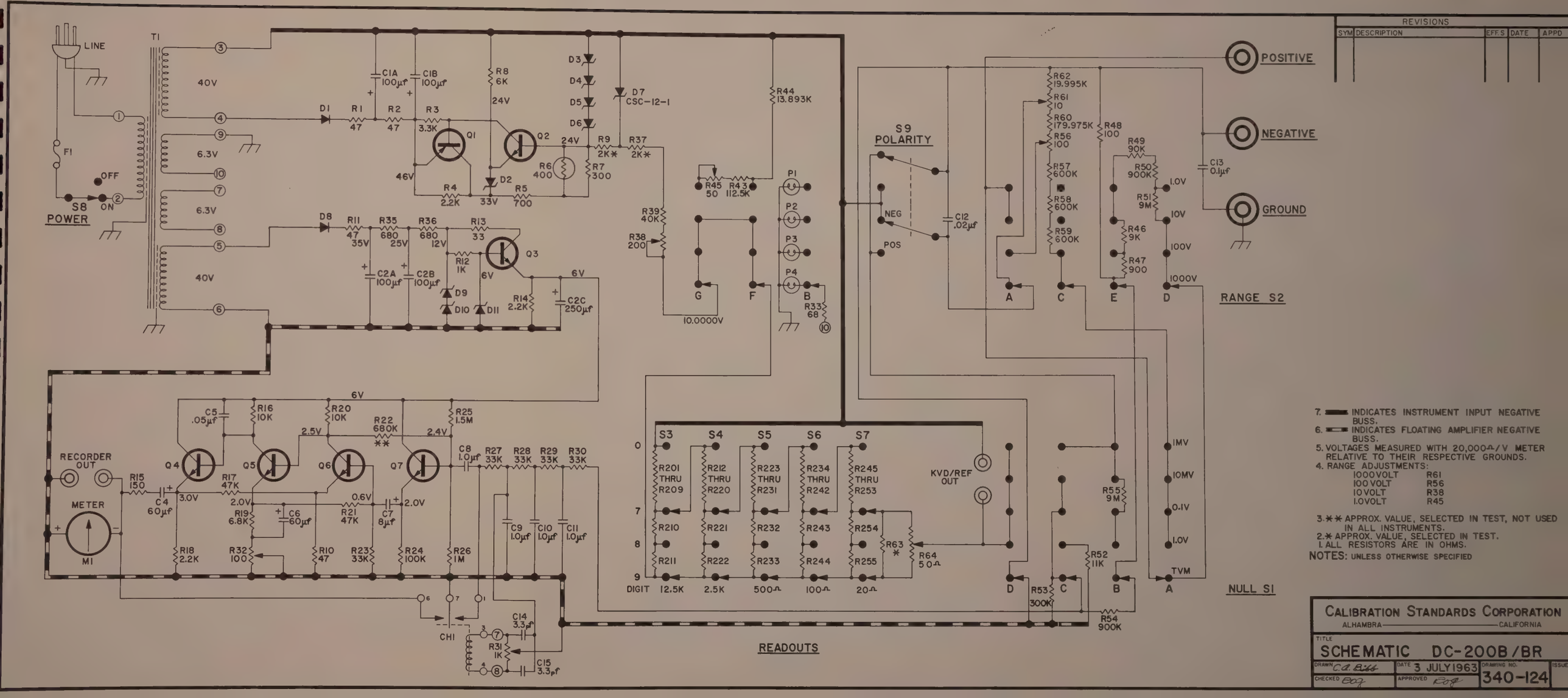
S1



NULL SWITCH
(PART 240-044)



SWITCHES VIEWED FROM KNOB END
SHOWN IN MAX. COUNTER CLOCKWISE
POSITION.



REVISIONS				
SYM	DESCRIPTION	EFF.S	DATE	APPD

7. ▬ INDICATES INSTRUMENT INPUT NEGATIVE BUSS.
6. ▬ INDICATES FLOATING AMPLIFIER NEGATIVE BUSS.
5. VOLTAGES MEASURED WITH 20,000Ω/V METER RELATIVE TO THEIR RESPECTIVE GROUNDS.
4. RANGE ADJUSTMENTS:

1000 VOLT	R61
100 VOLT	R56
10 VOLT	R38
1.0 VOLT	R45

3. ** APPROX. VALUE, SELECTED IN TEST, NOT USED IN ALL INSTRUMENTS.
2. * APPROX. VALUE, SELECTED IN TEST.
1. ALL RESISTORS ARE IN OHMS.

NOTES: UNLESS OTHERWISE SPECIFIED

CALIBRATION STANDARDS CORPORATION
ALHAMBRA — CALIFORNIA

TITLE: SCHEMATIC DC-200B/BR

DRAWN	DATE	DRAWING NO.	ISSUE
C.A. Bixt	3 JULY 1963	340-124	
CHECKED	APPROVED		

REPLACEMENT PARTS LIST

Reference or Quantity	Description	Stock Number
Reference Supply Sub-Assembly, 400-107		
R1, R2	Resistor, FC, 47Ω, 10%, 1/2W	201-470
R3	Resistor, FC, 3.3KΩ, 10%, 1/2W	201-332
R4	Resistor, FC, 2.2KΩ, 10%, 1/2W	201-222
R5	Resistor, DC, 700Ω, 1%, 1/2W	205-032
R6	Resistor, NTC, 400Ω	209-001
R7	Resistor, DC, 300Ω, 1%, 1/2W	205-021
R8	Resistor, DC, 6KΩ, 1%, 1/2W	205-042
R9	Resistor, Wire Wound	*
R37	Resistor, Wire Wound	*
C1A, C1B	Capacitor, Dual Electrolytic, 100-100 mfd, 50 vdc	222-013
D1	Diode	216-025
D2	Zener Diode	216-008
D3, D4, D5, D6	Zener Diode	216-004C
D7	Zener Diode, CSC 12-1	*
Q1	Transistor, PNP Silicon	215-036A
Q2	Transistor, NPN Silicon	215-015A
2	Pad, Transistor	218-004

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
Amplifier Sub-Assembly, 400-106		
R10, R11	Resistor, FC, 47Ω, 10%, 1/2W	201-470
R12	Resistor, FC, 1KΩ, 10%, 1/2W	201-102
R13	Resistor, FC, 33Ω, 10%, 1/2W	201-330
R14, R18	Resistor, FC, 2.2KΩ, 10%, 1/2W	201-222
R15	Resistor, FC, 150Ω, 10%, 1/2W	201-151
R16, R20	Resistor, FC, 10KΩ, 10%, 1/2W	201-103
R17, R21	Resistor, FC, 47KΩ, 10%, 1/2W	201-473
R19	Resistor, FC, 6.8KΩ, 10%, 1/2W	201-682
R22	Resistor, FC, 680KΩ, 10%, 1/2W	201-684
R23, R27, R28, R29, R30	Resistor, FC, 33KΩ, 10%, 1/2W	201-333
R24	Resistor, FC, 100KΩ, 10%, 1/2W	201-104
R25	Resistor, FC, 1.5MΩ, 10%, 1/2W	201-155
R26	Resistor, FC, 1.0MΩ, 10%, 1/2W	201-105
R35, R36	Resistor, FC, 680Ω, 10%, 1/2W	201-681
R31	Resistor, Variable, 1KΩ	210-010
R32	Resistor, Variable, 200Ω	210-009
C2A, C2B, C2C	Capacitor, Triple Electrolytic, 100-100-250 mfd, 50-50 vdc	222-014
C4, C6	Capacitor, Tantalum, 60 mfd, 6 vdc	223-008
C5	Capacitor, Disc, .05 mfd, 75 vdc	220-002
C7	Capacitor, Tantalum, 8.2 mfd, 20 vdc	223-009

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
Amplifier Sub-Assembly, 400-106 (continued)		
C8, C9, C10, C11	Capacitor, Mylar, 1 mfd, 100 vdc	220-033
D8	Diode	216-025
D9, D10	Zener Diode	216-004C
D11	Zener Diode	216-004A
Q3, Q4, Q5, Q6, Q7	Transistor, NPN Silicon	215-015A
CH1	Chopper	230-004
5	Pad, Transistor	218-004
1	Socket, 7-pin	260-011
C14, C15	Capacitor, 3.3 mmf	220-007

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
Calibration Board Sub-Assembly, 400-108		
R39	Resistor, WW, 40KΩ, .05%, 1/3W	203-503
R43	Resistor, WW, 112.5KΩ, .02%, 1/3W	203-504
R44	Resistor, WW, 13.893KΩ, .02%, 1/3W	203-501
R46	Resistor, DC, 9KΩ, 1%, 1/2W	205-001
R47	Resistor, DC, 900Ω, 1%, 1/2W	205-039
R48	Resistor, DC, 100Ω, 1%, 1/2W	205-036
R49	Resistor, DC, 90KΩ, 1%, 1/2W	205-004
R50, R54	Resistor, DC, 900KΩ, 1%, 1/2W	205-002
R51, R55	Resistor, DC, 9MΩ, 1%, 1/2W	205-005
R52	Resistor, DC, 11KΩ, 1%, 1/2W	205-008
R53	Resistor, DC, 300KΩ, 1%, 1/2W	205-009
R57, R58, R59	Resistor, WW, 600KΩ, .02%, 1/3W	203-551
R60	Resistor, WW, 179.975KΩ, .02%, 1/3W	203-521
R61	Resistor, Variable, 10Ω	210-015
R62	Resistor, WW, 19.995KΩ, .02%, 1/3W	203-502
R45	Resistor, Variable, 50Ω	210-014
R38	Resistor, Variable, 200Ω	210-009
R56	Resistor, Variable, 100Ω	210-011

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
Kelvin-Varley Divider, 12,500Ω, Sub-Assembly, 400-115**		
S3	Switch, Rotary	240-046
R201-R211	Resistor, WW, 12.5KΩ, .01%, 1/3W	203-303
Kelvin-Varley Divider, 2,500Ω, Sub-Assembly, 400-116**		
S4	Switch, Rotary	240-046
R212-R222	Resistor, WW, 2.5KΩ, .05%, 1/3W	203-132
Kelvin-Varley Divider, 500Ω, Sub-Assembly, 400-117**		
S5	Switch, Rotary	240-046
R223-R233	Resistor, WW, 500Ω, .05%, 1/3W	203-102
Kelvin-Varley Divider, 100Ω, Sub-Assembly, 400-110		
S6	Switch, Rotary	240-046
R234-R244	Resistor, WW, 100Ω, .1%	203-106
Kelvin-Varley Divider, 20Ω, Sub-Assembly, 400-111		
S7	Switch, Rotary	240-046
R245-R255	Resistor, WW, 20Ω, .5%	203-107
R64	Resistor, Variable, WW, 50Ω	210-016
R63	Resistor, FC, 10%, 1/2W	***

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
T1	Power Transformer, 115 vac, 50-60 cps Power Transformer, 230 vac, 50-60 cps	235-014 235-016
C12	Capacitor, Disc, .02 mfd, 1K vdc	220-001
F1	Fuse, 3 AG, 1/8 amp	261-001
1	Fuse Holder	261-002
1	Line Cord	264-001
1	Strain Relief	283-001
5	KVD Switch Readout Dial	400-112
1	KVD Pot Readout Dial	400-113
S1	Switch, Rotary, Null	240-044
S2	Switch, Rotary, Range	240-045
S8	Switch, Toggle, SPST	240-047
S9	Switch, Toggle, DPDT	240-026
M1	Meter, 100-0-100 micro-amp	250-008
1	Bezel, meter	250-009
1	Terminal Post, Red	263-105
2	Terminal Post, Black	263-106
R33	Resistor, FC, 68Ω, 10%, 1/2W	201-680
4	Lamp, Decimal	400-114
2	Knob, Range & Null	214-010
6	Knob, KVD	214-011
1	Cover, Instrument (B only)	310-080
1	Handle, Instrument (B only)	285-004

REPLACEMENT PARTS LIST (Continued)

Reference or Quantity	Description	Stock Number
4	Feet, Rubber	283-003
1	Test Lead, Red	264-003
1	Test Lead, Black	264-002
C13	Capacitor, 0.1 mfd, 1000 vdc	220-040

NOTES

* (A) D7, the reference Zener diode, is carefully selected and stabilized by Calibration Standards Corporation. R9 is a precision wire wound resistor carefully selected to control the current through the reference diode, D7. R37 is a precision wire wound resistor, factory selected to drop the reference voltage from 13.5 ±5% vdc to 10.000 vdc. Failure of these components is extremely remote. It is recommended that the instrument be returned to the factory if a problem is suspected.

** (B) The resistors forming the Kelvin-Varley decks are factory matched to achieve an overall accuracy better than ±.002% absolute. The 12.5K deck resistors are matched to .001% of each other; the 2500Ω and 500Ω to within .0025%. When ordering, include instrument model and serial number.

*** (C) R64 is matched to the balance of the Kelvin-Varley divider by means of R63. R63 is factory selected and may vary in value from instrument to instrument.

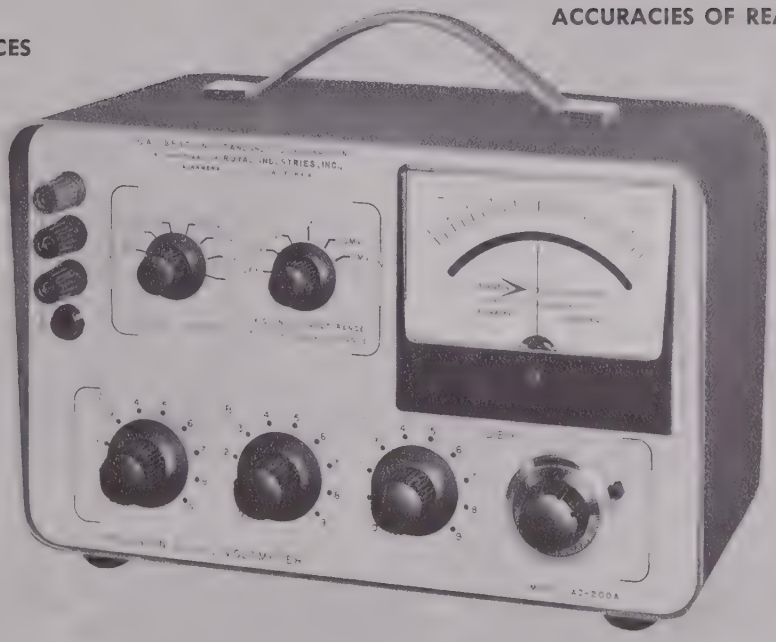
PRECISION VOLTMETER

SHORT CATALOG

CONTINUOUSLY SELF-CALIBRATING

ACCURACIES OF READING, NOT FULL SCALE

ULTRA-STABLE ZENER REFERENCES



5 & 6 DIGIT READOUTS

NO ZERO CONTROLS

ALL TRANSISTORIZED

ACK AND CABINET MODELS

LIGHTWEIGHT

PLUG-IN MODULES

OW POWER CONSUMPTION

0—1000 VDC
.05—1000 VAC

ULTRA-STABLE KELVIN-VARLEY DIVIDER

±1 MILLIVOLT NULL SENSITIVITY

COMPACT, PORTABLE

CALIBRATED BY PRIMARY STANDARDS

INFINITE INPUT IMPEDANCE

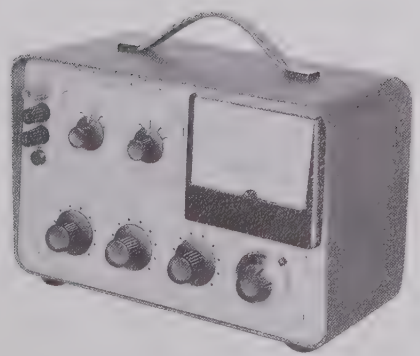
PRECISION, AGED RESISTORS

CALIBRATION STANDARDS CORPORATION

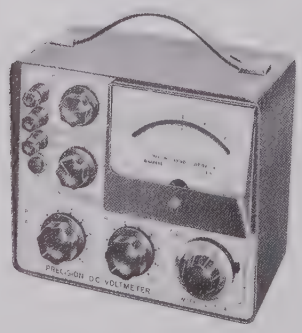
ALL CALIBRATION STANDARDS PRECISION VOLTMETERS

FEATURES

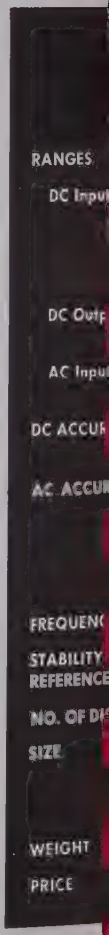
- Continuously Self-Calibrating (60 times per second)
- Ultra-Stable Zener References (Series 200 Instruments, 0.001%/year, 0.001% for 10% line change, 2PPM/°C; Series 100 Instruments, 0.01%/year, 0.005% for 10% line change, 5PPM/°C; Series 110 Instruments, 0.005%/year, 0.005% for 10% line change, 3PPM/°C)
- Precision selected and aged wire-wound resistors with stability of 0.001%/year (Series 200) and 0.005%/year (Series 100)
- No Zero Controls necessary
- No Calibration Controls necessary
- Lightweight, Compact, Portable
- All Transistorized
- Low Power consumption
- All Accuracies stated are of reading, not full scale
- Measurement Ranges of 0 to 1000 volts DC and .05 to 1000 volts AC
- 6 digit readout for Series 200 Instruments, 5 digit readout for Series 100 Instruments
- Most sensitive Null range is ±1 millivolt for AC and DC measurements
- All instruments calibrated by Primary Standards with traceability to the Bureau of Standards
- Certificates supplied upon request
- All instruments available in cabinet and rack models
- Recorder output to facilitate long term strip chart recording
- Operation is the same for both AC and DC measurements
- Ultra-Stable Kelvin-Varley Divider
- Infinite Input Impedance
- Differential Input
- Plug-in Modules



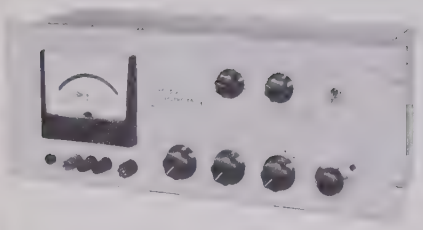
DC VOLTMETER MODEL DC-200A



DC VOLTMETER MODEL DC-110A

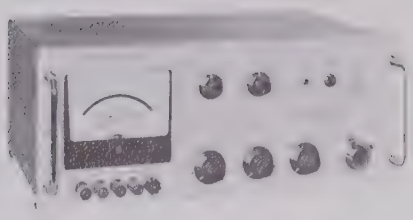


PRECISION ELECTRONIC INSTRUMENTS FOR INDUSTRY

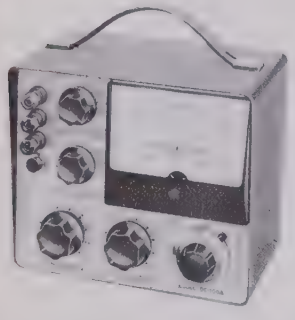


AC/DC VOLTMETER MODEL AC-200AR

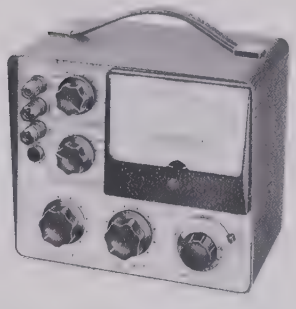
AC/DC CONVERTER MODEL C-100AR



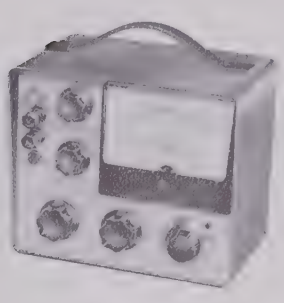
DC VOLTAGE CALIBRATOR MODEL VC-200A



DC VOLTMETER MODEL DC-100A



DC VOLT-AMP METER MODEL VA-100A



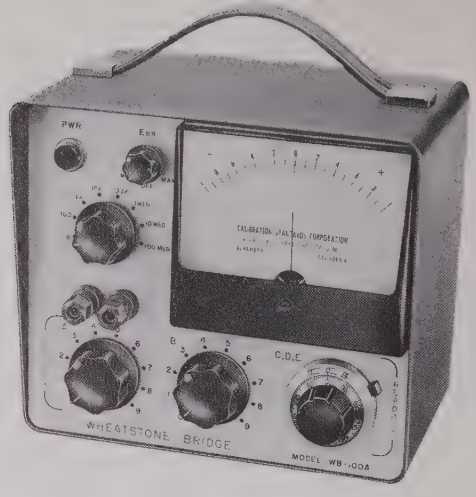
AC/DC VOLTMETER MODEL AC-100A

AC-200A AC-200AR	DC-200A DC-200AR	AC-100A AC-100AR	DC-100A DC-100AR	DC-110A DC-110AR	VA-100A VA-100AR	VC-200A VC-200AR	C-100A C-100AR	C-700A C-700AR
0-1v, 10v, 100v, 1000v	0-1v, 10v, 100v, 1000v	0-.1v, 1v, 10v, 100v, 1000v	0-.1v, 1v, 10v, 100v, 1000v	0-.1v, 1v, 10v, 100v, 1000v	0-.1v, 1v, 10v, 100v, 1000v 0-.01 ma, .1 ma, 1 ma, 10 ma, 100 ma, 1 amp	0-1v, 10v, 100v, 1000v		
						0-1v, 10v, 100v, 1000v	0-10v	0-10v
0-10v, 100v, 1000v		0-10v, 100v, 1000v					0-10v, 100v, 1000v	0-10v, 100v, 1000v
0.01% +5 μv	0.01% +5 μv	0.05% +5 μv	0.05% +5 μv	0.025% +5 μv	0.05% +5 μv 0.1% +.001 μa	0.01% +5 μv		
0.15% 30 CPS–50 CPS 0.1% 50 CPS–5 KC 0.15% 5 KC–10 KC		0.2%					0.15%	0.15% 30 CPS–50 CPS 0.1% 50 CPS–10 KC 0.15% 10 KC–20 KC
30 CPS–10 KC		30 CPS–10 KC					30 CPS–10 KC	30 CPS–20 KC
0.001% per yr.	0.001% per yr.	0.01% per yr.	0.01% per yr.	0.005% per yr.	0.01% per yr.	0.001% per yr.	0.05% per 30 days	0.025% per 30 days
6	6	5	5	5	5	6*		
A–12"w. x 7"h. x 6"d. AR–19"w. x 7"h. x 6"d.	A–12"w. x 7"h. x 6"d. AR–19"w. x 7"h. x 6"d.	A–8"w. x 7"h. x 6"d. AR–19"w. x 7"h. x 6"d.	A–8"w. x 7"h. x 6"d. AR–19"w. x 7"h. x 6"d.	A–8"w. x 7"h. x 6"d. AR–19"w. x 7"h. x 6"d.	A–8"w. x 7"h. x 6"d. AR–19"w. x 7"h. x 6"d.	A–17"w. x 7"h. x 12"d. AR–19"w. x 7"h. x 12"d.	A–8"w. x 7"h. x 6"d. AR–19"w. x 5¼"h. x 6"d.	A–8"w. x 7"h. x 6"d. AR–19"w. x 3½"h. x 6"d.
14 lbs.	12 lbs.	11 lbs.	9 lbs.	9 lbs.	7 lbs.	25 lbs.	7 lbs.	7 lbs.
A –$1425.00 AR–$1445.00	A –$965.00 AR –$985.00	A –$855.00 AR–$875.00	A –$475.00 AR–$495.00	A –$550.00 AR $570.00	A –$625.00 AR–$645.00	A –$1440.00 AR–$1440.00	A –$535.00 AR–$555.00	A –$825.00 AR–$845.00

*6 Digit Readout As Voltmeter, 6 Digit Dialout As Power Supply.

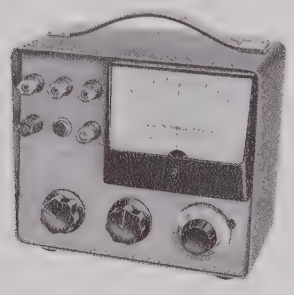
COMBINATION GALVANOMETER, POWER SUPPLY AND WHEATSTONE BRIDGE MODELS WB-100A and WB-110A

CSC's unique 3 in 1 combination offers users an unusually accurate, ultra-sensitive Wheatstone Bridge, all transistorized chopper readout amplifier and a bridge voltage power supply in a single, compact, lightweight and portable instrument for laboratory and production line test. Priced below competitive instruments, both the Model WB-100A and WB-110A provide High Resolution and a 5 digit readout over the full range. The instruments can be used as resistance comparators. They are available in both cabinet and rack mount.



ACCURACY:
WB-100A: ±0.05% + .005 ohm absolute.
WB-110A: ±.025% + .003 ohm absolute.
RANGE: 1 ohm to 100 megohms in 8 ranges.
SENSITIVITY: 1 mv for full scale.
READOUT: 5 digits.
INPUT VOLTAGE: 117 VAC, 50-60 cps.
WEIGHT: 8 lbs.
SIZE:
WB-100A & WB-110A: 8"w., 7"h., 6"d.
WB-100AR & WB-110AR: 19"w., 7"h., 6"d.
PRICE:
WB-100A: $575.00.
WB-100AR: $595.00.
WB-110A: $685.00.
WB-110AR: $705.00.

REGULATION MONITORS MODELS RM-2A, RM-2A-3, RM-2A-5



Designed specifically to measure the stability of any DC voltage from 2.0 volts to 500 volts, CSC's three Regulation Monitors read out directly in percent deviation. Drift is less than 0.005% for an 8 hour day and short term drift is less than 0.002%. At maximum sensitivity, the meter shows a full scale deflection for a deviation of ±0.1%. Fully transistorized for stable, reliable operation, the instruments incorporate ultra-stable Zener References and precision, aged wire-wound resistors. Sensitivity Range is ±0.001% to ±10% in 3 ranges, ±.1% F.S., ±1% F.S., and ±10% F.S. Major applications include check out of regulated DC power supplies, drift measurement of equipment during environmental test and design, performance and drift measurement of such components as zener diodes, transistors, gas filled regulators, batteries and resistors and in repair and calibration laboratories to trouble shoot drift problems in electronic instruments and systems.

TEMPERATURE STABILITY: ±0.0005% /°C from 10-40°C.
SENSITIVITY: .1%, 1%, 10% full scale.
VOLTAGE RANGE:
RM-2A: 2-500 VDC.
RM-2A-3: 2-3000 VDC.
RM-2A-5: 2-5000 VDC.
CALIBRATION ACCURACY: ±5% of reading + one small scale division on all ranges.
SMALLEST READABLE DEVIATION: 0.001%.
INPUT RESISTANCE: 7000 ohms per volt or greater.

	15 volt range	100K
	50 volt range	350K
RM-2A:	150 volt range	1.1 meg.
	500 volt range	3.5 meg.
RM-2A-3:	3000 volt range	21.0 meg.
RM-2A-5:	5000 volt range	35.0 meg.

STABILITY: Less than 0.005% change from 100 to 130 VAC.
WEIGHT:
RM-2A: 7 lbs.
RM-2A-3: 8 lbs.
RM-2A-5: 8 lbs.
SIZE:
RM-2A, RM-2A-3 & RM-2A-5: 8"w., 7"h., 6"d.
RM-2AR, RM-2AR-3 & RM-2AR-5: 19"w., 7"h., 6"d.
PRICE:
RM-2A: $390.00.
RM-2AR: $410.00.
RM-2A-3: $485.00.
RM-2AR-3: $505.00.
RM-2A-5: $595.00.
RM-2AR-5: $615.00.

Calibration Standards Corporation designs and manufactures Self-Calibrating, Transistorized Precision Electronic Instruments for Industry including . . .

AC and DC Precision Voltmeters that combine extremely wide measurement ranges with Accuracies of ±0.1% absolute (.5-1000 VAC), ±0.01% + 5 microvolts absolute (0-1000 VDC) and Stability of ±0.005%/yr.

Dual Purpose Voltage Calibrators that provide 0-1000 VDC as a Power Supply and measure 0-1000 VDC with Accuracies of ±0.01% and Stability of ±0.005%/yr.

Combination Volt-Amp meters accurate to ±0.05% (0-1000 volts) and ±0.1% (0-1 amp).

Unique, ultra-sensitive Galvanometer, Power Supply and Wheatstone Bridge in a single package.

Voltage Regulation Monitors to measure voltage stability and to final check DC regulated power supplies.

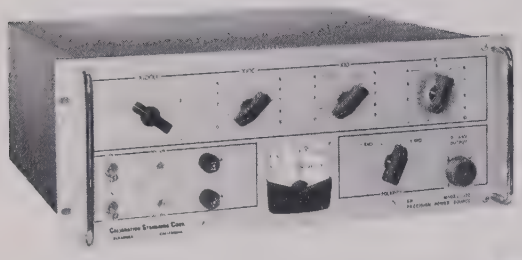
Primary Voltage References with Guaranteed Stability of 2PPM/3 months, 3PPM/yr. and Accuracy of ±0.0015%.

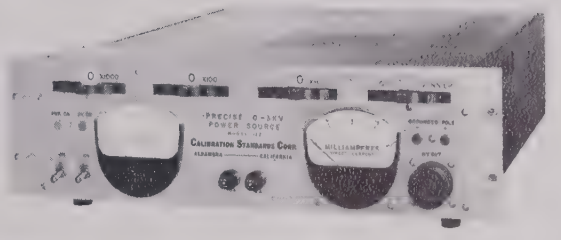
All Accuracies are of reading, not full scale.

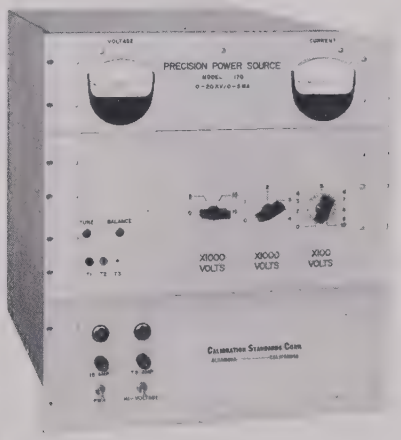
CALIBRATION > STANDARDS CORPORATION
A subsidiary of ROYAL INDUSTRIES, INC.
1031 Westminster Avenue
Alhambra, California

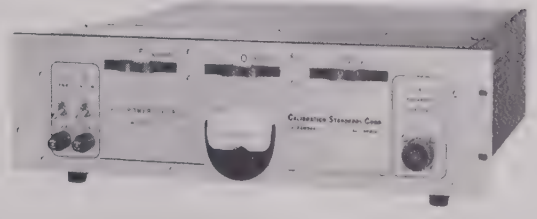
PRECISION POWER SOURCE

SHORT CATALOG







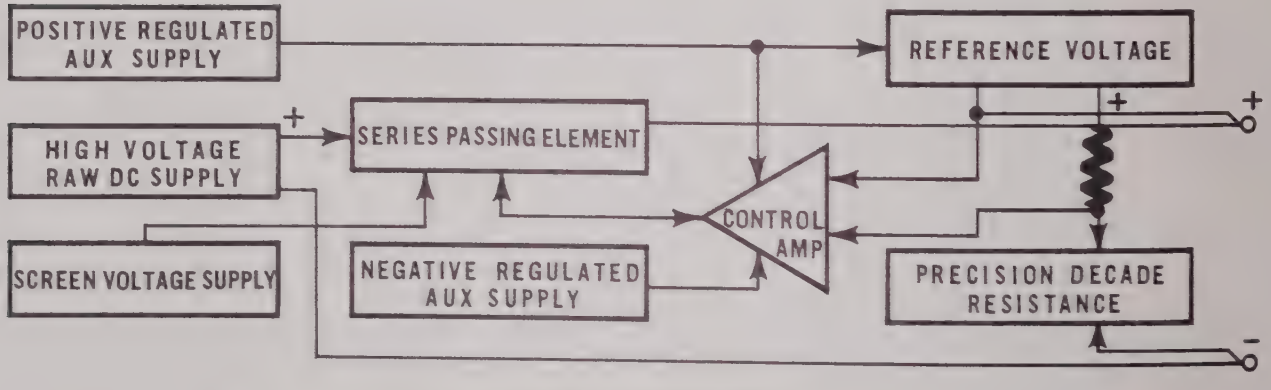


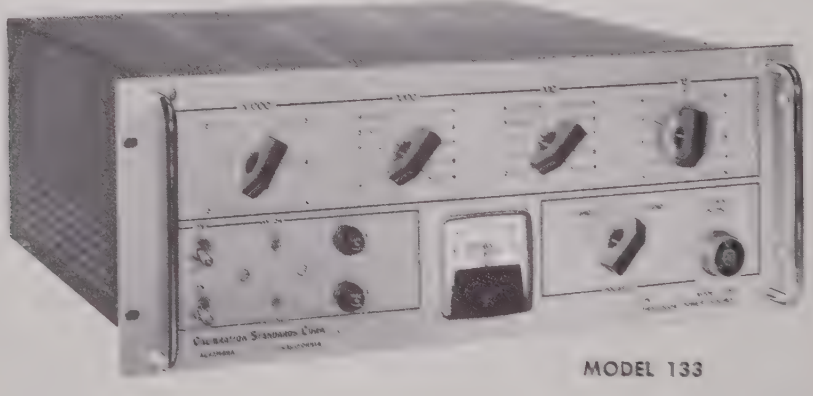
CALIBRATION STANDARDS CORPORATION

CALIBRATION STANDARDS
PRECISION POWER SOURCES*
INCORPORATE THESE OUTSTANDING
FEATURES

- "Handi-Vider" controls to provide easy readout and operation
- All operating controls on front panel
- Current and Voltage metering
- Automatic Polarity indication lamps
- In-line readout
- Front panel polarity switch
- Separate circuit fusing
- Ability to be cycled repeatedly at any preset voltage without damage
- Front and rear output connectors
- Minimum depth behind front panel
- Rubber feet for bench use

BLOCK DIAGRAM MODEL 133

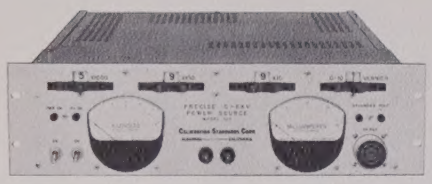




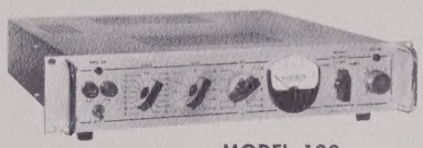
MODEL 133

*formerly Smith-Florence

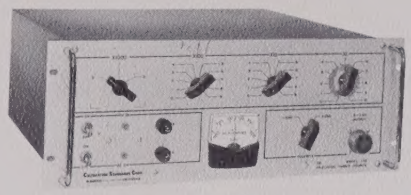
PRECISION ELECTRONIC INSTRUMENTS FOR INDUSTRY



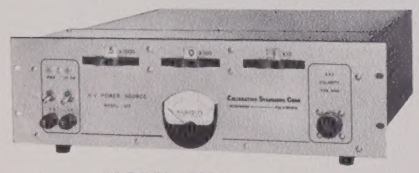
MODEL 123



MODEL 120



MODEL 132



MODEL 127

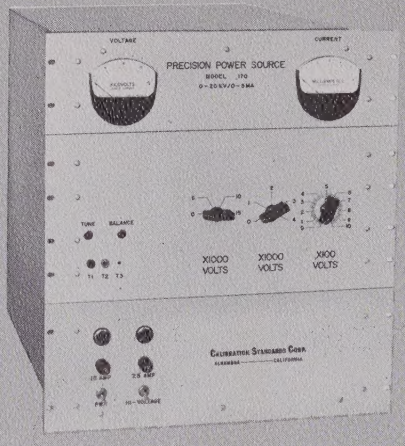
MODEL 122

Model	120	122	123	127 (N or P)	132	133	170
Input Voltage:	105-130 VAC 50/60 cps	105-130 VAC 50/60 cps	105-130 VAC 50/60 cps	105-130 VAC 50/60 cps	105-130 VAC 50/60 cps	105-130 VAC 50/60 cps	105-130 VAC 50/60 cps
Output Voltage:	500-2210 VDC	0-3 kv	0-6 kv	.5-3 kv DC	0-3 kv	0-6 kv	0-20,000 VDC
Output Current:	0-20 ma	0-20 ma	0-20 ma	0-2 ma	0-20 ma	0-20 ma	0-5 ma
Output Polarity:	Positive or negative	Positive or negative	Positive or negative	N—Negative P—Positive	Positive or negative (front panel switch)	Positive or negative (front panel switch)	Positive or negative (specify) (May be simply inverted)
Stability:	.005%/hr. .03%/day	.005%/hr. .03%/day	.005%/hr. .03%/day	.02%/hr.	.005%/hr. .03%/day	.005%/hr. .03%/day	.1%/hr., .3%/day Above 1KV level
Reg. VS. Line:	.01% for ±10% line change	.005% for ±10% line change	.005% for ±10% line change	Better than .02%	.01% for ±10% line change	.01% for ±10% line change	Better than .1% Above 1KV level
Reg. VS. Load:	.01% for 20 ma change	.005% for 20 ma change	.005% for 20 ma change	Better than .02%	.01% for 20 ma change	.01% for 20 ma change	Better than .1% (zero to full load) Above 1KV level
Resolution:	10 mv at any output voltage	10 mv at any output voltage	10 mv at any output voltage	Better than 100 mv	10 mv at any output voltage	10 mv at any output voltage	1V
Accuracy:	.25%	.25%	.25%	.5%	.25%	.25%	1%
Metering:	(One) 0-3 kv	Current and voltage	Current and voltage		Zero center 3 kv—0-3 kv	Zero center 6 kv—0-6 kv	
Ripple:	Less than 5 mv RMS at any output voltage and current in either polarity	Less than 5 mv RMS at any output voltage and current in either polarity	Less than 5 mv RMS at any output voltage and current in either polarity	Less than 5 mv RMS	Less than 5 mv RMS at any output voltage and current in either polarity	Less than 5 mv RMS at any output voltage and current in either polarity	Less than 1V RMS
Connectors:	Front and rear-mating connector supplied	Front and rear-mating connector supplied	Front and Rear Mating connector supplied	Front and rear (1) Mating connector supplied	Front and rear (1) Mating connector supplied	Front and rear (1) Mating connector supplied	(1) on rear (mating connector supplied)
Size:	3½″H x 19″W x 15″D	5¼″H x 19″W x 18″D	5¼″H x 19″W x 18″D	5¼″H x 19″W x 16″D	19″W x 15″D x 7″H	19″W x 15″D x 7″H	19″W x 21″H x 18″D
Net Weight:	29 lbs.	49 lbs.	53 lbs.	30 lbs.	40 lbs.	42 lbs.	200 lbs.
Shipping Weight:	40 lbs.	61 lbs.	65 lbs.	38 lbs.	50 lbs.	52 lbs.	230 lbs.

PRECISION
20 KV HIGH VOLTAGE SOURCE
MODEL 170

Calibration Standards' 20 KV High Voltage Precision Power Source, Model 170, is the outgrowth of over two years study and research of high voltage DC generation techniques. An entirely new high voltage design concept was developed due to the limited components available.

Basically, the system follows the principle of generating a low frequency a.c. signal applied through an intermediate driver stage to a conventional linear amplifier. The amplifier provides approximately 10,000 VAC from its special high Q tank circuit to a conventional high voltage rectifier-doubler and filter circuit which produces an output of slightly more than 20,000 volts of unregulated d.c. This 20 kv of d.c. is applied across a precision resistance string. At a precise lower level on the string, a d.c. potential is compared to a well regulated variable reference source of d.c. The error signal from the comparison amplifier is then applied to the screen of the driver (at a low level) which in turn controls the high voltage output amplifier stages.

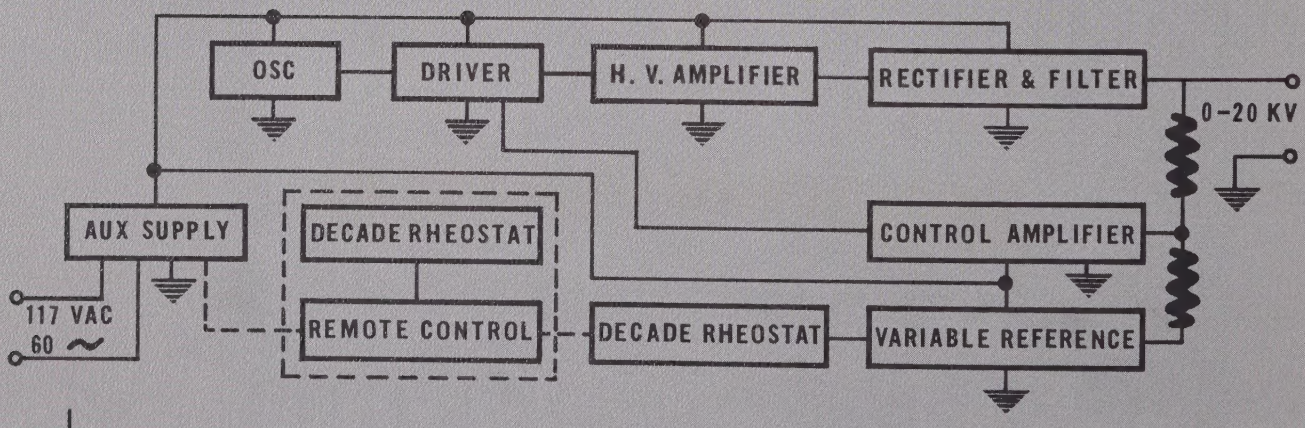


The Model 170 has many interesting features, some of which are: that it may be taken to zero voltage output, has extremely low ripple, is self-protected from inadvertent overload, and may be remote programmed with more than one channel of control.

SPECIFICATIONS

INPUT VOLTAGE:	105-130 VAC, 50/60 cps
OUTPUT VOLTAGE:	0-20,000 VDC
OUTPUT CURRENT:	0-5 ma
OUTPUT POLARITY:	Positive or negative (specify) (May be simply inverted)
STABILITY:	.1%/hr., .3%/day (Above 1 KV level)
REG. VS. LINE:	Better than .1% (Above 1 KV level)
REG. VS. LOAD:	Better than .1% (zero to full load) (Above 1 KV level)
RESOLUTION:	1V
ACCURACY:	1% directly off controls
RIPPLE:	Less than 1V RMS
CONNECTORS:	(1) on rear (mating connector supplied)
SIZE:	19" W x 21" H x 18" D
NET WEIGHT:	200 lbs.
SHIPPING WEIGHT:	230 lbs.

MODEL 170 BLOCK DIAGRAM



CALIBRATION STANDARDS CORPORATION

A subsidiary of ROYAL INDUSTRIES, INC.
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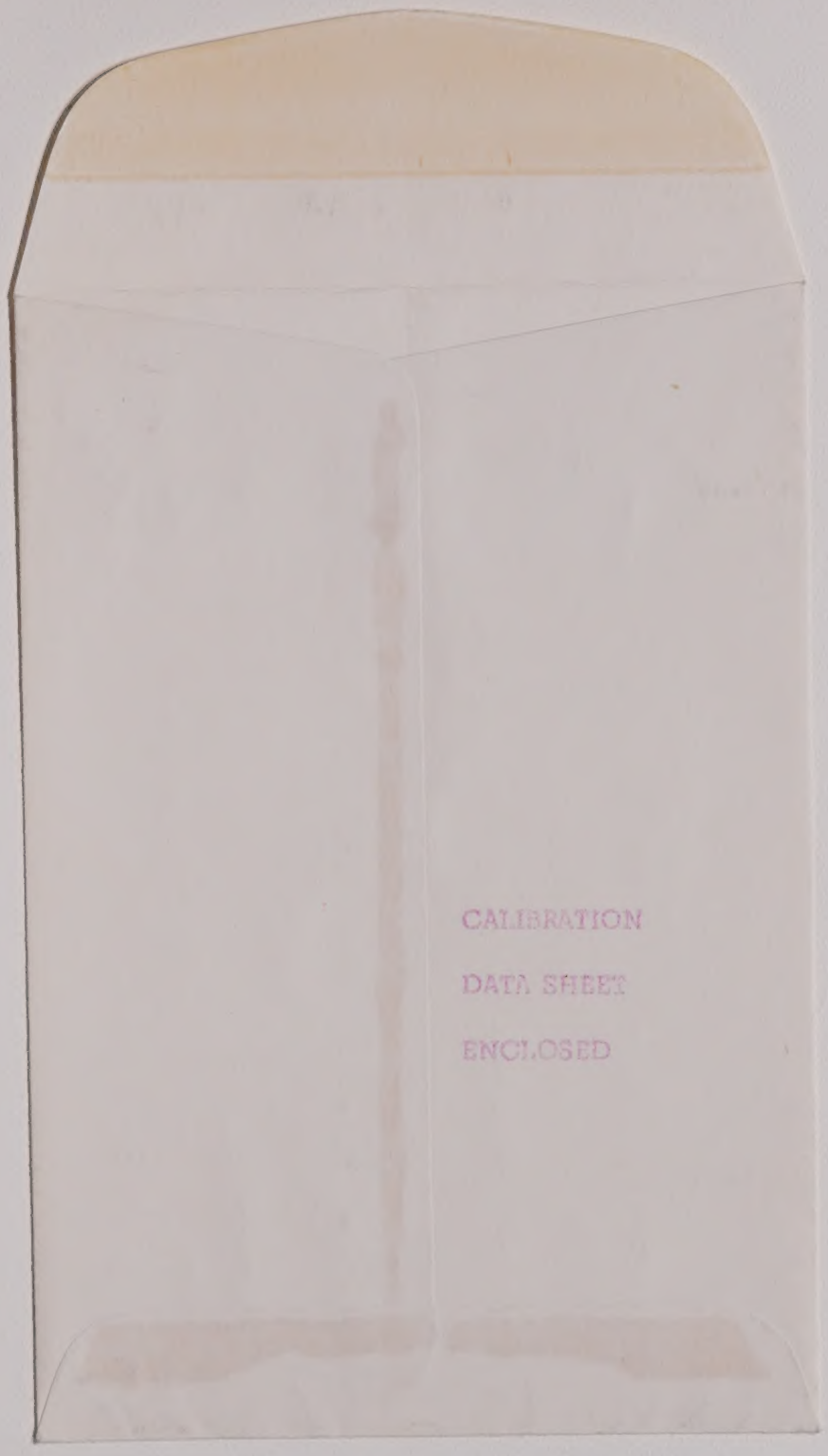
CALIBRATION
DATA SHEET
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